Only one other organization—Global Insight, Inc. (GII, formerly DRI-WEFA)—produces a comprehensive energy projection with a time horizon similar to that of *AEO2003*. The most recent projection from GII, as well as other forecasts that concentrate on economic growth, international oil prices, electricity, natural gas, petroleum, and coal, are compared here with the *AEO2003* projections.

Economic Growth

The *AEO2003* forecast period has been extended through 2025. Through 2020 the macroeconomic forecast is similar to the *AEO2003* forecast for the same period. From 2001 to 2020 both *AEO2002* and *AEO2003* project real gross domestic product (GDP) growth of 3.1 percent per year (Table 14). From 2001 to 2025, *AEO2003* projects real GDP grow of 3.0 percent per year, slightly less than the May 2002 GII forecast of 3.1 percent. Through 2012, the *AEO2003* forecast of 3.2 percent is similar to other forecasts: the GII forecast is 3.2 percent, the same as the July 2002 forecast by the Office of Management and Budget (OMB), and the August 2002 forecasts by the Congressional Budget Office (CBO) and Oxford Economic Forecasting (OEF) show 3.1-percent growth per year through 2012. The September 2002 forecast by Deutsche Banc Alex.Brown (DBAB) shows U.S. economic growth at 3.5 percent per year from 2000 to 2025.

Table 14. Forecasts of annual average economic growth, 2001-2025

	Average annual percentage growth		
Forecast	**2001-2012**	**2001-2020**	**2001-2025**
AEO2002	3.2	3.1	
AEO2003			
Reference	3.2	3.1	3.0
Low growth	2.8	2.6	2.5
High growth	3.8	3.6	3.5
GII	3.2	3.1	3.1
OMB	3.2	—	—
CBO	3.1	—	—
OEF	3.1	—	—
DBAB	—	—	3.5*

**DBAB average annual growth rate is for 2000-2025.*
Note: Totals may not equal sum of components due to independent rounding.

Table 15. Forecasts of world oil prices, 2000-2025

	2001 dollars per barrel					
Forecast	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**
AEO2003						
Reference	28.35	23.27	23.99	24.72	25.48	26.57
High price	28.35	28.65	32.51	32.95	33.02	33.05
Low price	28.35	22.04	19.04	19.04	19.04	19.04
Altos	NA	22.64	23.40	25.58	27.90	31.61
GII	28.12	21.28	22.09	23.54	25.08	NA
IEA	28.63	21.47	21.47	21.47	25.56	27.61
PEL	28.63	21.21	18.46	17.47	NA	NA
PIRA	31.00	22.43	23.33	26.32	NA	NA
NRCan	22.28	22.28	22.28	22.28	22.28	NA
DBAB	28.01	19.04	19.04	18.94	19.34	19.18
EEA	28.87	20.98	20.47	19.98	19.50	NA

NA = not available.

World Oil Prices

Comparisons with other oil price forecasts—including GII, the International Energy Agency (IEA), Petroleum Economics Ltd. (PEL), Petroleum Industry Research Associates, Inc. (PIRA), Natural Resources Canada (NRCan), DBAB, Altos Partners, and Energy and Environmental Analysis, Inc. (EEA)—are shown in Table 15 (GII, Spring-Summer 2002; IEA, September 2002; PEL, June 2002; PIRA, October 2002; NRCan, 1997, reaffirmed in September 2002; DBAB, September 2002; Altos, October 2002; EEA, October 2002). With the exception of PEL, which falls below the *AEO2003* low world oil price case in 2010 and 2015; EEA, GII, IEA, PEL, and DBAB, which fall below the *AEO2003* low price case in 2005; and DBAB, which falls below the *AEO2003* low price case in 2015, the range between the *AEO2003* low and high world oil price cases spans the range of published forecasts.

Total Energy Consumption

The *AEO2003* forecast of end-use sector energy consumption shows relatively greater growth in petroleum, natural gas, and coal consumption and slower growth in electricity consumption (Table 16) than occurred between 1980 and 2001. Much of the

Table 16. Forecasts of average annual growth rates for energy consumption (percent)

		Projections		
		AEO2003		
Energy use	**History 1980-2001**	**2001-2020**	**2001-2025**	**GII 2001-2020**
*Petroleum**	0.8	1.8	1.7	1.5
*Natural gas**	0.3	1.4	1.4	1.4
*Coal**	-1.7	0.1	0.1	0.1
Electricity	2.3	1.9	1.8	2.0
Delivered energy	0.7	1.7	1.6	1.4
Electricity losses	1.9	1.2	1.1	0.6
Primary energy	1.0	1.5	1.5	1.3

**Excludes consumption by electricity generators.*

projected growth in petroleum consumption is driven by increased demand in the industrial sector for petrochemical and manufacturing applications and in the transportation sector as improvement in vehicle efficiency slows. Natural gas consumption is expected to grow more rapidly in the residential, commercial, and industrial sectors as it displaces a portion of petroleum and coal consumption. Coal consumption is projected to remain virtually constant as a result of growing emissions concerns and fuel switching.

Electricity is expected to remain the fastest growing source of delivered energy, although its projected rate of growth in both the *AEO2003* and GII forecasts is down from historical rates, because many traditional uses of electricity (such as for air conditioning) approach saturation while average equipment efficiencies rise. The *AEO2003* projections are generally consistent with the outlook from GII; however, GII forecasts slightly faster growth in natural gas and electricity consumption and slower growth in petroleum and coal consumption, resulting from differences in relative prices and projected growth in each sector.

Residential Sector

The projected growth rates for primary energy demand in the residential sector are lower than the rates between 1980 and 2001, largely because of projected lower growth in households. Other contributing factors include increasing energy efficiency due to technical innovations and legislated standards; voluntary government efficiency programs; and reduced opportunities for additional market penetration of such end uses as air conditioning.

Differing views on the growth of new uses for energy contribute to variations among the forecasts. By fuel, electricity (excluding generation and transmission losses) remains the fastest growing energy source for the sector in both the *AEO2003* and GII forecasts (Table 17). Both project faster growth in electricity use than in the number of households, implying that new uses for electricity will outweigh future efficiency improvements. Natural gas use is projected to grow at roughly the rate of households in the *AEO2003* forecast, whereas GII projects stronger growth in natural gas use than in households. Petroleum use in the residential sector fell by 0.7 percent per year from 1980 to 2001, and *AEO2003* shows that trend continuing through 2025, with petroleum use projected to fall by 0.5 percent per year. GII, on the other hand, projects 0.2-percent annual growth for residential petroleum use through 2020.

Commercial Sector

The recent historical growth trend for delivered commercial energy use is projected to continue, with *AEO2003* and GII projecting slightly higher and slightly lower growth rates, respectively, than occurred between 1980 and 2001. The growth rate for primary energy demand in the commercial sector is expected to decrease significantly from the rate between 1980 and 2001, largely because of lower projected growth in electricity demand and in the energy losses associated with the generation, transmission, and distribution of electricity.

As in the residential sector, electricity (excluding generation and transmission losses) remains the fastest growing energy source in both forecasts (Table 18). The forecasts show substantial growth in electricity use, with slower growth in the *AEO2003* projections toward the end of the forecast. Natural gas use is projected to grow more slowly than electricity use, and petroleum use continues to fall in both projections. *AEO2003* projects a slower decline in commercial oil demand than GII, because GII projects a shift from oil to electricity for heating and more rapid improvement in building shell efficiency than is projected in *AEO2003*.

Table 17. Forecasts of average annual growth in residential energy demand (percent)

	History	Projections		
		AEO2003		GII
Energy use	1980-2001	2001-2020	2001-2025	2001-2020
Petroleum	-0.7	-0.5	-0.5	0.2
Natural gas	0.1	1.1	1.1	1.4
Electricity	2.5	1.7	1.6	2.1
Delivered energy	0.4	1.1	1.1	1.5
Electricity losses	2.1	1.0	0.9	0.7

Table 18. Forecasts of average annual growth in commercial energy demand (percent)

	History	Projections		
		AEO2003		GII
Energy use	1980-2001	2001-2020	2001-2025	2001-2020
Petroleum	-2.8	-0.2	-0.1	-0.4
Natural gas	1.1	1.3	1.3	1.1
Electricity	3.7	2.2	2.2	2.0
Delivered energy	1.6	1.7	1.6	1.4
Electricity losses	3.3	1.5	1.5	0.6

Industrial Sector

The projected growth rates for delivered energy consumption in the industrial sector are 1.4 percent per year in *AEO2003* (Table 19) and 1.2 percent per year in the GII forecast. A source of difference in the two forecasts is renewable energy consumption, which was 1.8 quadrillion British thermal units (Btu) in 2001 but is not reflected in the GII forecast. In *AEO2003*, industrial renewable energy use is projected to grow by 2.2 percent per year. Growth of renewables reduces the requirements for other fuels, including purchased electricity, because biomass is used extensively for combined heat and power. Neither forecast reflects the 0.1-percent annual decline in industrial delivered energy consumption over the 1980-2001 period (primarily the result of a sharp drop in industrial economic activity in 2001, which also reduced energy consumption). In the *AEO2003* and GII forecasts, electricity and natural gas use are projected to grow more rapidly than either petroleum or coal use in the industrial sector.

Transportation Sector

Overall fuel consumption in the transportation sector is expected to grow at a rate similar to its growth rate over the recent past in both the *AEO2003* and GII forecasts (Table 20). The projection for gasoline demand is higher in *AEO2003* than in the GII forecast, primarily because higher growth is projected for light-duty vehicle travel and lower growth is projected for new car efficiency in *AEO2003* than in the GII projection. GII projects more rapid growth in air travel, and therefore more rapid growth in jet fuel consumption, and projects slower growth in diesel fuel demand. Both forecasts anticipate slower growth in light-duty vehicle travel and in air travel than in recent history. Demand for diesel fuel is also expected to grow more slowly in both forecasts than it has in the past.

Table 19. Forecasts of average annual growth in industrial energy demand (percent)

		Projections		
	History	AEO2003		GII
Energy use	1980-2001	2001-2020	2001-2025	2001-2020
Petroleum	-0.4	1.2	1.2	1.0
Natural gas	0.3	1.6	1.6	1.4
Coal	-1.7	0.1	0.1	0.1
Electricity	1.0	1.7	1.6	2.0
Delivered energy	-0.1	1.4	1.4	1.2
Electricity losses	0.6	1.0	1.0	0.6
Primary energy	0.1	1.3	1.3	1.0

Electricity

Comparison across the *AEO2003*, GII, and EEA forecasts shows slight variation in projected electricity sales (Table 21). The forecasts for total electricity sales in 2020 range from 4,643 billion kilowatthours in the *AEO2003* low economic growth case to 5,095 billion kilowatthours in the *AEO2003* high economic growth case. The *AEO2003* reference case projection of 4,850 is slightly less than the GII forecast and nearly identical to the EEA forecast. Demand growth rates range from 1.8 percent in the *AEO2003* reference case, to 1.9 percent in both the GII and EEA forecasts, to 2.1 percent in the *AEO2003* high economic growth case. Both price forecasts (EEA does not forecast electricity prices) show competition in wholesale markets and slow growth in electricity demand relative to GDP growth contributing to declining electricity prices in real terms through 2025.

The GII forecast assumes that the U.S. electric power industry will be fully restructured, resulting in average electricity prices that approach long-run marginal costs. *AEO2003* assumes that partial restructuring will lead to increased competition in the electric power industry, lower operating and maintenance costs, lower general and administrative costs, early retirement of inefficient generating units, and other cost reductions. *AEO2003* projects a slight decline in electricity prices over the full range of the forecast; however, average prices increase slightly over the last 7 years of the forecast as capacity margins tighten and natural gas prices climb. In contrast,

Table 20. Forecasts of average annual growth in transportation energy demand and key indicators (percent)

		Projections		
	History	AEO2003		GII
Energy use	1980-2001	2001-2020	2001-2025	2001-2020
Motor gasoline	1.5	2.1	2.0	1.6
Diesel fuel	3.6	2.5	2.4	1.4
Jet fuel	2.4	2.1	2.1	3.4
Residual fuel	-2.7	0.1	0.2	0.2
All energy	1.6	2.1	2.0	1.8
Key indicators				
Car and light truck travel	3.0	2.4	2.3	1.9
Air travel (revenue passenger-miles)	4.9	2.6	2.4	3.8
Average new car fuel efficiency	1.1	0.3	0.3	0.5
Gasoline prices	-1.7	0.0	0.2	-0.4

Table 21. Comparison of electricity forecasts (billion kilowatthours, except where noted)

Projection	2001	AEO2003			Other forecasts	
		Reference	Low economic growth	High economic growth	GII	EEA
		2015				
Average end-use price (2001 cents per kilowatthour)	**7.3**	**6.5**	**6.2**	**6.7**	**5.5**	**NA**
Residential	8.6	7.7	7.4	8.1	6.7	NA
Commercial	7.9	6.9	6.6	7.2	5.8	NA
Industrial	4.8	4.4	4.1	4.5	4.0	NA
Net energy for load, including CHP	**3,770**	**5,024**	**4,881**	**5,208**	**5,269**	**5,158**
Coal	1,904	2,391	2,331	2,468	2,546	2,320
Oil	125	53	50	53	118	124
Natural gas [a]	624	1,223	1,155	1,314	1,295	1,346
Nuclear	769	805	805	805	693	735
Hydroelectric/other [b]	301	469	463	478	420	366
Nonutility sales to grid [c]	27	56	52	62	164	229
Net imports	20	26	24	29	33	38
Electricity sales	**3,414**	**4,481**	**4,357**	**4,642**	**4,583**	**4,405**
Residential	1,201	1,539	1,518	1,557	1,613	1,557
Commercial/other [d]	1,219	1,671	1,644	1,698	1,599	1,584
Industrial	994	1,271	1,195	1,387	1,371	1,264
Capability, including CHP (gigawatts) [e]	**851**	**1,051**	**1,022**	**1,091**	**1,161**	**1,001**
Coal	315	333	327	342	388	331
Oil and natural gas	321	482	461	509	559	452
Nuclear	98	99	99	99	94	92
Hydroelectric/other	117	130	129	131	139	126
		2020 [f]				
Average end-use price (2001 cents per kilowatthour)	**7.3**	**6.6**	**6.4**	**6.8**	**5.2**	**NA**
Residential	8.6	7.8	7.5	8.1	6.3	NA
Commercial	7.9	7.2	6.9	7.3	5.5	NA
Industrial	4.8	4.5	4.3	4.7	3.7	NA
Net energy for load, including CHP	**3,770**	**5,434**	**5,198**	**5,722**	**5,697**	**5,680**
Coal	1,904	2,553	2,441	2,687	2,826	2,562
Oil	125	52	58	49	106	106
Natural gas [a]	624	1,452	1,341	1,585	1,492	1,585
Nuclear	769	807	807	807	657	739
Hydroelectric/other [b]	301	486	475	498	417	397
Nonutility sales to grid [c]	27	67	59	77	167	250
Net imports	20	17	17	17	31	40
Electricity sales	**3,414**	**4,850**	**4,643**	**5,095**	**4,973**	**4,835**
Residential	1,201	1,640	1,598	1,670	1,781	1,693
Commercial/other [d]	1,219	1,852	1,799	1,902	1,715	1,793
Industrial	994	1,358	1,246	1,523	1,477	1,349
Capability, including CHP (gigawatts) [e]	**851**	**1,129**	**1,081**	**1,185**	**1,240**	**1,070**
Coal	315	353	339	370	408	364
Oil and natural gas	321	532	504	565	624	467
Nuclear	98	100	100	100	88	92
Hydroelectric/other	117	133	131	135	139	148

[a]Includes supplemental gaseous fuels.
[b]"Other" includes conventional hydroelectric, pumped storage, geothermal, wood, wood waste, municipal waste, other biomass, solar and wind power, plus a small quantity of petroleum coke.
[c]For *AEO2003*, includes only net sales from combined heat and power plants.
[d]"Other" includes sales of electricity to government, railways, and street lighting authorities.
[e]EIA capacity is net summer capability, including combined heat and power plants. GII capacity is nameplate, excluding cogeneration plants.
[f]Electric power projections for 2025 were not available from GII and EEA. For *AEO2003* projections, see Appendixes A and B.
CHP = combined heat and power. NA = not available.
Sources: ***AEO2003:*** AEO2003 National Energy Modeling System, runs AEO2003.D110502C (reference case), LM2003.D110502C (low economic growth case), and HM2003.D110502C (high economic growth case). **GII:** DRI-WEFA (now Global Insight, Inc.), *Winter 2001-2002 U.S. Energy Outlook* (May 2002). **EEA:** Energy and Environmental Analysis, Inc., *EEA's Compass Service Base Case* (October 2002).

GII projects a larger decline over the forecast period from 2001-2020, despite higher natural gas prices and more nuclear retirements than are projected in *AEO2003*. The difference is largely attributable to greater net additions in the GII forecast (116 gigawatts), and a retirement rate for older units nearly twice that projected in the *AEO2003* reference case.

Both *AEO2003* and GII incorporate large amounts of planned capacity in the short term, with *AEO2003* projecting about 91 gigawatts through 2003 and GII projecting about 85 gigawatts, virtually all of which is expected to be gas-fired. The two forecasts project a glut of capacity with falling prices in the near term, along with steady capacity margins that begin to erode only in the later years. All three forecasts project that demand will grow fastest in the commercial sector and that more cycling and baseload capability will be built than peaking units, which typically are more sensitive to residential demand. All the forecasts show growth rates for electricity demand in the commercial sector of 2.3 percent through 2010, compared with residential sector demand growth of 2.1 percent in *AEO2003* and GII and 1.7 percent in EEA, leading to moderate increases in the share of baseload capacity relative to all additions. All the forecasts show significant gross additions to coal-fired capacity: 45 gigawatts by 2020 in *AEO2003*, 57 gigawatts in the EEA forecast, and nearly 89 gigawatts in the GII forecast. GII projects 15 gigawatts of nuclear retirements, much more than *AEO2003* (3 gigawatts) or EEA (4 gigawatts). Moreover, *AEO2003* projects incremental capacity increases at many existing nuclear units, as well as the entry of Browns Ferry 1 into service, for a net increase in total nuclear capacity and generation over the forecast.

Natural Gas

The difference among published forecasts of natural gas prices, production, consumption, and imports (Table 22) indicate the uncertainty of future market trends. Because the forecasts depend heavily on the underlying assumptions that shape them, the assumptions should be considered when different projections are compared. For instance, the GII forecast incorporates a cyclical price trend based on exploration and production cycles, which can be deceptive when isolated years are considered.

In both 2015 and 2020, the other forecasts are within the range of projected consumption levels in the *AEO2003* low and high economic growth cases. Total natural gas consumption in the other forecasts is lower than the *AEO2003* reference case projection in both 2015 and 2020. While the expected growth in residential consumption in *AEO2003* is slightly lower than in the GII and EEA forecasts, PIRA's projection is markedly lower than the rest, by about half. Growth in commercial natural gas use is similar across the forecasts, with the EEA forecast showing a somewhat higher growth rate. Natural gas consumption in the industrial and electric power sectors is more difficult to compare, given potential definitional differences. Although all the forecasts show significantly greater growth in the electric power sector, both PIRA and EEA show faster growth in the electric power sector and less in the industrial sector than do the other forecasts.

Domestic natural gas consumption is met by domestic production and imports. All the forecasts show domestic production providing a decreasing share of total natural gas supply, but *AEO2003* shows a smaller shift in that direction. Both PIRA and EEA show significantly higher (more than double) liquefied natural gas (LNG) imports and notably lower pipeline imports than *AEO2003* and GII. GII shows somewhat higher pipeline imports than *AEO2003*.

With the exception of EEA's projection for 2015, all the wellhead price projections in *AEO2003* are higher than the other forecasts, in part because *AEO2003* projects generally higher domestic production levels, except in the low economic growth case. Unfortunately, price comparisons in isolated years can be deceptive. For instance, the projected wellhead price in 2020 is lower in the *AEO2003* high economic growth case than in the reference case, because initial flows from the Alaskan pipeline occur earlier in the high growth case than in the reference case, causing prices to drop below the reference case even with higher total production levels in that year. In addition, the incorporation of production cycles in the GII forecast makes particular year comparisons deceptive. Information about whether or when the other forecasts include Alaskan gas flows to the lower 48 States was not available.

For the residential and commercial sectors, end-use margins relative to wellhead prices are in a similar range in the *AEO2003* and GII forecasts, whereas the EEA forecast shows significantly lower margins relative to wellhead prices. Price margins for the electric power sector are similar across all the forecasts, but industrial price margins are notably lower in

Table 22. Comparison of natural gas forecasts (trillion cubic feet, except where noted)

Projection	2001	AEO2003			Other forecasts		
		Reference	Low economic growth	High economic growth	GII [a]	EEA [b]	PIRA
		2015					
Lower 48 wellhead price (2001 dollars per thousand cubic feet)	**4.12**	**3.55**	**3.26**	**3.71**	**3.14**	**3.81**	**NA**
Dry gas production [c]	**19.36**	**23.83**	**23.08**	**24.16**	**23.44**	**23.40**	**22.34**
Net imports	**3.64**	**5.27**	**4.89**	**6.33**	**6.21**	**6.40**	**6.35**
Consumption	**22.64**	**29.50**	**28.38**	**30.90**	**29.42**	**29.20**	**28.80**
Residential	*4.81*	*5.69*	*5.60*	*5.78*	*5.94*	*6.00*	*5.25*
Commercial	*3.25*	*3.89*	*3.84*	*3.95*	*3.90*	*4.00*	*3.68*
Industrial [d]	*7.53*	*9.53*	*9.00*	*10.24*	*7.52 [e]*	*8.40 [f]*	*5.61 [g]*
Electricity generators [h]	*5.26*	*8.01*	*7.63*	*8.51*	*9.63 [i]*	*8.60 [j]*	*12.17 [k]*
Other [l]	*1.79*	*2.38*	*2.30*	*2.43*	*2.44*	*2.20*	*2.08*
End-use prices (2001 dollars per thousand cubic feet)							
Residential	*9.96*	*7.90*	*7.57*	*8.07*	*7.33*	*7.33*	*NA*
Commercial	*8.29*	*6.83*	*6.50*	*7.01*	*6.27*	*6.62*	*NA*
Industrial [d]	*4.97*	*4.29*	*3.98*	*4.50*	*4.31 [m]*	*4.98*	*NA*
Electricity generators [h]	*4.69*	*4.21*	*3.90*	*4.42*	*3.73*	*4.59*	*NA*
		2020 [n]					
Lower 48 wellhead price (2001 dollars per thousand cubic feet)	**4.12**	**3.69**	**3.58**	**3.63**	**3.23**	**3.10**	**NA**
Dry gas production [c]	**19.36**	**25.07**	**24.48**	**26.60**	**24.31**	**24.50**	**NA**
Net imports	**3.64**	**6.66**	**5.40**	**7.58**	**6.73**	**7.80**	**NA**
Consumption	**22.64**	**32.14**	**30.30**	**34.59**	**30.79**	**31.90**	**NA**
Residential	*4.81*	*5.96*	*5.76*	*6.14*	*6.31*	*6.40*	*NA*
Commercial	*3.25*	*4.17*	*4.03*	*4.32*	*3.97*	*4.40*	*NA*
Industrial [d]	*7.53*	*10.10*	*9.30*	*11.27*	*7.74 [e]*	*8.50 [f]*	*NA*
Electricity generators [h]	*5.26*	*9.39*	*8.76*	*10.12*	*10.27 [i]*	*10.20 [j]*	*NA*
Other [l]	*1.79*	*2.53*	*2.45*	*2.75*	*2.51*	*2.40*	*NA*
End-use prices (2001 dollars per thousand cubic feet)							
Residential	*9.96*	*7.96*	*7.87*	*7.88*	*7.37*	*6.39*	*NA*
Commercial	*8.29*	*6.94*	*6.82*	*6.88*	*6.32*	*5.71*	*NA*
Industrial [d]	*4.97*	*4.44*	*4.29*	*4.43*	*4.38 [m]*	*4.24*	*NA*
Electricity generators [h]	*4.69*	*4.38*	*4.23*	*4.38*	*3.93*	*3.86*	*NA*

[a]Previously DRI-WEFA. A factor of 1.0236 was applied to convert prices in 2000 dollars to 2001 dollars.
[b]The baseline projection includes a cyclical price trend based on exploration and production cycles; therefore, forecast values for an isolated year may be misleading. EEA's average wellhead price is $3.30 between 2010 and 2020.
[c]Does not include supplemental fuels.
[d]Includes consumption for combined heat and power; excludes consumption by nonutility generators.
[e]Excludes natural gas used for cogeneration or other nonutility generation.
[f]Includes natural gas consumed in cogeneration.
[g]Excludes gas demand for nonutility generation.
[h]Includes consumption of energy by electricity-only and combined heat and power (CHP) plants whose primary business is to sell electricity, or electricity and heat, to the public. Includes small power producers and exempt wholesale generators.
[i]Includes gas used in cogeneration and other nonutility generation.
[j]Includes independent power producers and excludes cogenerators.
[k]Equals the sum of gas demand for nonutility generation (NUG) plus gas demand for utility generation.
[l]Includes lease, plant, and pipeline fuel and fuel consumed in natural gas vehicles.
[m]On system sales or system sales (i.e., does not include gas delivered for the account of others).
[n]Natural gas projections for 2025 were not available from GII, EEA, and PIRA. For *AEO2003* projections, see Appendixes A and B.
NA = not available.
Sources: **2001:** Energy Information Administration, *Annual Energy Review 2001*, DOE/EIA-0384(2001) (Washington, DC, November 2002). ***AEO2003*:** AEO2003 National Energy Modeling System, runs AEO2003.D110502C (reference case), LM2003.D110502C (low economic growth case), and HM2003.D110502C (high economic growth case). **GII:** DRI-WEFA (now Global Insight, Inc.), *Winter 2001-2002 U.S. Energy Outlook* (May 2002). **EEA:** Energy and Environmental Analysis, Inc., *EEA's Compass Service Base Case* (October 2002). **PIRA:** PIRA Energy Group (October 2002).

AEO2003 than in the other forecasts. Given that there are similar disparities in the historical prices provided with the other forecasts, the difference is probably attributable to differences in definition.

Petroleum

Eight world oil price forecasts are compared with the *AEO2003* reference, low world oil price, and high world oil price cases in Table 15. The *AEO2003* high price case projects the highest oil price in 2015, $32.95 per barrel (2001 dollars). Petroleum Economics Ltd. (PEL) projects the lowest price for 2015, $17.47 per barrel. For 2020, the *AEO2003* high world oil price case is highest at $33.02 per barrel, and the *AEO2003* low world oil price case is lowest at $19.04 per barrel. Overall, only PEL projects a substantial decline in the world oil price. NRCan is constant at $22.28 per barrel through 2020, and the low world oil price case and DBAB are consistent, varying by at most 40 cents per barrel. The other forecasts show increasing real crude oil prices.

More detailed projections of domestic petroleum production, consumption, and imports were obtained from GII and DBAB (Table 23). Both project peak domestic crude oil and natural gas liquids (NGL) production in 2015. U.S. crude oil and NGL production was 7.67 million barrels per day in 2001. DBAB projects an increase in crude oil and NGL production of 130,000 barrels per day from 2001 to 2015; after 2015, projected production declines rapidly, falling to a level that is 1.8 million barrels per day below 2001 levels in 2025. GII projects an increase in crude oil and NGL production of 200,000 barrels per day by 2015, falling to 50,000 barrels per day above 2001 levels in 2020. GII and the *AEO2003* reference and low and high world oil price cases project monotonically increasing NGL production from 2001 on. The reason for comparing total crude oil and NGL production is that DBAB does not separate crude oil and NGL production.

The *AEO2003* low world oil price and reference cases project that domestic crude and natural gas liquid production will reach a minimum, rather than a maximum, around 2015. The high world oil price case projects monotonically rising crude oil and NGL production from 2001 to 2025. The *AEO2003* reference and high world oil price cases and DBAB project an increase in crude oil and NGL production over 2001 levels by 2025. The *AEO2003* low world oil price case projects output that is 160,000 barrels per day below the 2001 level, and DBAB projects an even greater decline of 1.8 million barrels per day by 2025. The *AEO2003* reference case projects 290,000 barrels per day more, and the high world oil price case projects 720,000 barrels per day more in 2025.

GII's projected oil price path assumes global economic growth of about 3 percent annually. It further assumes that OPEC and its allies will be disciplined enough to prevent oversupply while not attempting to raise prices excessively. No greenhouse gas emissions limits are assumed. The *AEO2003* reference case also leaves aside greenhouse gas emissions limits.

GII's oil demand forecast for the United States is driven by projected 1.6-percent annual growth in gasoline consumption. Distillate demand is projected to grow at a slower rate of 1.7 percent per year. Demand for air transport is projected to grow more rapidly than demand for road transport, resulting in a 3.4-percent annual increase in jet fuel demand from 2001 to 2020. The *AEO2003* reference case assumes somewhat higher gasoline and distillate demand growth over the same period, at 2.1 percent and 1.9 percent per year, respectively.

Apparently small differences in expected growth rates of petroleum product demand compound over time. The *AEO2003* reference case projects gasoline demand in 2020 that is higher than GII's by 1.13 million barrels per day and distillate demand that is higher by 630,000 barrels per day. GII's gasoline and distillate demand projections for 2020 are the lowest of the five forecasts examined. The *AEO2003* reference case projects much slower growth in jet fuel demand, 2.7 percent annually from 2001 to 2020, and its projections for jet fuel demand in 2020 is 660,000 barrels per day below the GII projection. DBAB's jet fuel demand projection for 2020 is 120,000 barrels per day below the *AEO2003* reference case and is the lowest of the five projections.

The imported share of petroleum product supply is projected to increase, even if real crude oil prices rise substantially. The share of demand met by imports was 55.4 percent in 2001. The *AEO2003* high world oil price case projects the smallest imported share of total petroleum product supply, 64.5 percent, for 2025. DBAB projects the highest import share at 73.6 percent in 2025.

Table 23. Comparison of petroleum forecasts (million barrels per day, except where noted)

Projection	2001	AEO2003			Other forecasts	
		Reference	Low world oil price	High world oil price	GII	DBAB
				2015		
World oil price (2001 dollars per barrel)	**22.01**	**24.72**	**19.04**	**32.95**	**23.69** [a]	**19.04**
Crude oil and NGL production	**7.67**	**7.66**	**7.48**	**8.08**	**7.87**	**7.80**
Crude oil	5.80	5.25	5.09	5.61	5.51 [b]	NA
Natural gas liquids	1.87	2.41	2.39	2.46	2.36	NA
Total net imports	**10.90**	**16.20**	**16.79**	**15.15**	**15.44**	**15.19**
Crude oil	9.31	12.36	12.79	11.91	11.10	NA
Petroleum products	1.59	3.84	4.01	3.24	4.34	NA
Petroleum demand	**19.69**	**25.23**	**25.71**	**24.59**	**24.77**	**24.56**
Motor gasoline	8.67	11.83	11.97	11.50	11.03 [c]	10.96
Jet fuel	1.66	2.17	2.18	2.15	2.68	2.14
Distillate fuel	3.81	5.05	5.18	4.97	4.53	4.56
Residual fuel	0.97	0.63	0.75	0.56	0.67	0.89
Kerosene	0.07	0.06	0.06	0.05	0.07	NA
Liquefied petroleum gas	2.05	2.66	2.69	2.59	2.75	NA
Other	2.46	2.83	2.88	2.78	3.04 [d]	NA
Import share of product supplied (percent)	**55.4**	**64.2**	**65.3**	**61.6**	**62.3**	**61.9**
				2020		
World oil price (2001 dollars per barrel)	**22.01**	**25.48**	**19.04**	**33.02**	**25.05** [a]	**19.04**
Crude oil and NGL production	**7.67**	**7.99**	**7.71**	**8.36**	**7.72**	**6.69**
Crude oil	5.80	5.46	5.22	5.79	5.30 [b]	NA
Natural gas liquids	1.87	2.53	2.49	2.58	2.42	NA
Total net imports	**10.90**	**17.72**	**18.57**	**16.47**	**17.09**	**18.25**
Crude oil	9.31	12.66	13.32	12.10	11.47	NA
Petroleum products	1.59	5.06	5.25	4.37	5.62	NA
Petroleum demand	**19.69**	**27.13**	**27.77**	**26.28**	**26.31**	**26.58**
Motor gasoline	8.67	12.78	13.00	12.27	11.65 [c]	11.81
Jet fuel	1.66	2.46	2.47	2.42	3.12	2.34
Distillate fuel	3.81	5.40	5.57	5.30	4.77	4.91
Residual fuel	0.97	0.64	0.76	0.58	0.60	0.95
Kerosene	0.07	0.05	0.06	0.05	0.07	NA
Liquefied petroleum gas	2.05	2.85	2.89	2.77	2.94	NA
Other	2.46	2.95	3.03	2.88	3.16 [d]	NA
Import share of product supplied (percent)	**55.4**	**65.3**	**66.9**	**62.7**	**65.0**	**68.7**
				2025		
World oil price (2001 dollars per barrel)	**22.01**	**26.57**	**19.04**	**33.05**	**NA**	**18.94**
Crude oil and NGL production	**7.67**	**7.96**	**7.51**	**8.39**	**NA**	**5.87**
Crude oil	5.80	5.33	4.92	5.71	NA	NA
Natural gas liquids	1.87	2.63	2.59	2.68	NA	NA
Total net imports	**10.90**	**19.79**	**21.12**	**18.19**	**NA**	**21.18**
Crude oil	9.31	13.06	14.05	12.53	NA	NA
Petroleum products	1.59	6.73	7.06	5.66	NA	NA
Petroleum demand	**19.69**	**29.17**	**30.17**	**28.19**	**NA**	**28.76**
Motor gasoline	8.67	13.77	14.10	13.12	NA	12.72
Jet fuel	1.66	2.74	2.75	2.70	NA	2.56
Distillate fuel	3.81	5.87	6.23	5.75	NA	5.29
Residual fuel	0.97	0.64	0.77	0.59	NA	1.01
Kerosene	0.07	0.05	0.05	0.05	NA	NA
Liquefied petroleum gas	2.05	3.03	3.10	2.98	NA	NA
Other	2.46	3.07	3.17	3.01	NA	NA
Import share of product supplied (percent)	**55.4**	**67.8**	**70.0**	**64.5**	**NA**	**73.6**

NA = Not available.

Notes: [a]GII world oil price is imported refiner acquisition cost in 2000 dollars, converted to 2001 dollars using *AEO2003* reference case chain-weighted price indexes. [b]GII crude oil production includes "other" domestic supply. [c]GII total for motor gasoline includes methanol. [d]GII "other" petroleum demand total includes naphthas, which are reported separately in GII's forecast.

Sources: ***AEO2003:*** AEO2003 National Energy Modeling System, runs AEO2003.D110502C (reference case), LW2003.D110502C (low world oil price case), and HW2003.D110502C (high world oil price case). **GII:** DRI-WEFA (now Global Insight, Inc.), *Winter 2001-2002 U.S. Energy Outlook* (May 2002). **DBAB:** Deutsche Banc Alex.Brown, "World Oil Supply and Demand Estimates," e-mail from Adam Sieminski, September 20, 2002.

Coal

The unknown factors affecting the future of the coal industry, including the continued uncertainty of pending environmental regulations, are evident when the *AEO2003* forecast for 2015 and 2020 is compared against those of Energy Ventures Analysis, Inc. (EVA) and Hill & Associates, Inc. The *AEO2003* reference case does not attempt to surmise when and how new environmental requirements may take effect, whereas the other forecasts may represent such assumptions. For instance, although *AEO2003* does represent the provisions of the State implementation plan (SIP) call for 19 States where NO_x caps have been finalized, it does not include revised limits on emissions of particulates, because no specific plan is yet in place. Other forecasts, including EVA and Hill & Associates, include further reductions of SO_2 beyond those set by CAAA90. EVA assumes that SO_2 emissions will be restricted to 4.5 million tons by 2008 and then further to 3 million tons in 2013. Hill & Associates assumes that SO_2 emissions face a further 50 percent reduction in 2010. The EVA forecast includes a 26 ton per year national limit on mercury emissions in 2008, followed by a 15 ton per year limit in 2013. It also includes a $5 per ton fee on carbon dioxide emissions beginning in 2013 and restricts emissions of nitrogen oxides to 2.1 million tons in 2008 and 1.7 million tons in 2013. Neither Hill & Associates nor *AEO2003* represents mercury or carbon dioxide reductions in its reference case.

Given the more restrictive assumptions of EVA's forecast, it is not surprising that *AEO2003* projects higher coal consumption levels in 2020. Hill & Associates and *AEO2003* project similar levels of consumption in 2020. All the forecasts show an increase in coal production and consumption between 2015 and 2020.

While *AEO2003* projects growing domestic consumption over the forecast horizon, it also projects a simultaneous reduction in real coal prices (Table 24). Hill & Associates projects average minemouth prices—excluding coking coal and exports—that are 5 cents per million Btu higher in 2015 and 17 cents per million Btu higher in 2020 than projected in the *AEO2003* reference case. EVA's projected national average minemouth price, although lower than the historical average in 2001, shows an increase of 1 percent (on a Btu basis) between 2015 and 2020. *AEO2003*, unlike EVA and Hill & Associates, projects a decline in minemouth prices between 2015 and 2020 of 1 percent (on a Btu basis). The decline in prices in the *AEO2003* forecast is driven by the expectation of continued improvements in labor productivity, which has a high negative correlation with prices, and the continued market expansion of western coal, which has a lower minemouth price than eastern coals.

As western production makes further inroads into markets traditionally supplied by eastern coal, the average heat content of the coals produced and consumed will drop as well, reflecting the lower thermal content per ton of western than eastern coals. The *AEO2003* and EVA forecasts indicate similar average heat contents (calculated by dividing dollars per ton by dollars per million Btu). The average heat content of coal production in the EVA and *AEO2003* forecasts is 20.4 million Btu per ton in 2015 and 20.3 in 2020. These similarities seem to indicate comparable shares of western production in the two forecasts. In contrast, the average heat content associated with coal production in the Hill & Associates projections for 2015 and 2020 is 21.7 million Btu per ton, indicating a relatively larger share of eastern production.

Gross exports of coal represent a small part of domestic coal production. In *AEO2003*, their share of total production is expected to fall from 4 percent in 2001 to 2 percent in 2020. Currently, coal is the only domestic energy resource whose net exports are still positive. EVA projects that this will change by 2020, and the United States will import more coal than it exports. *AEO2003* also projects that the United States will become a net importer of coal, but not until 2024. Hill & Associates projects that net coal exports will decline as well, but by a less significant margin, estimating net exports of 17 million tons in 2015 and 16 million tons in 2020. Strong price competition from other exporters and the loss of markets as Europe moves away from coal for environmental reasons are among the causes for the long-term decline in export projections.

The coal forecasts reviewed reflect the great uncertainties facing the U.S. coal industry as it must simultaneously adapt to the financial pressures arising from increasing environmental restrictions on coal use (both here and in Europe), deregulation of the U.S. electricity generation industry, and increasing competition from the younger coal fields of international competitors.

Table 24. Comparison of coal forecasts (million short tons, except where noted)

Projection	2001	AEO2003			Other forecasts	
		Reference	Low economic growth	High economic growth	EVA	Hill & Associates
				2015		
Production	**1,138**	**1,286**	**1,258**	**1,322**	**1,121**	**1,357**
Consumption by sector						
Electricity generation	957	1,187	1,162	1,221	1,039	1,260
Coking plants	26	22	22	22	24	18
Industrial/other	67	73	71	76	58	62
Total	**1,050**	**1,282**	**1,254**	**1,319**	**1,120**	**1,339**
Net coal exports	**29**	**6**	**6**	**6**	**1**	**17**
Exports	49	29	29	29	34	NA
Imports	20	22	22	22	34	NA
Minemouth price						
(2001 dollars per short ton)	17.59	14.67	14.54	14.76	15.73 [a]	16.73 [b,c]
(2001 dollars per million Btu)	0.83	0.72	0.71	0.72	0.77 [a]	0.77 [b,c]
Average delivered price to electricity generators						
(2001 dollars per short ton)	25.06	23.16	22.78	23.62	NA	20.95 [c]
(2001 dollars per million Btu)	1.25	1.15	1.13	1.17	NA	1.06 [c]
				2020 [d]		
Production	**1,138**	**1,359**	**1,314**	**1,412**	**1,171**	**1,402**
Consumption by sector						
Electricity generation	957	1,263	1,222	1,313	1,093	1,312
Coking plants	26	20	20	20	23	15
Industrial/other	67	74	71	78	57	59
Total	**1,050**	**1,358**	**1,313**	**1,411**	**1,172**	**1,387**
Net coal exports	**29**	**4**	**4**	**4**	**-1**	**16**
Exports	49	29	29	29	35	NA
Imports	20	25	25	25	36	NA
Minemouth price						
(2001 dollars per short ton)	17.59	14.38	14.06	14.79	15.83 [a]	19.11 [b,c]
(2001 dollars per million Btu)	0.83	0.71	0.69	0.72	0.78 [a]	0.88 [b,c]
Average delivered price to electricity generators						
(2001 dollars per short ton)	25.06	22.45	21.85	23.20	NA	22.20 [c]
(2001 dollars per million Btu)	1.25	1.12	1.10	1.15	NA	1.11 [c]

[a]The average coal price is a weighted average of the projected spot market FOB mine price for all domestic coal.
[b]The minemouth price represents an average for domestic steam coal only. Exports and coking coal are not included in the average.
[c]The prices provided by Hill & Associates were converted from 2002 dollars to 2001 dollars in order to be consistent with *AEO2003*.
[d]Coal projections for 2025 were not available from EVA and Hill & Associates. For *AEO2003* projections, see Appendixes A and B.
Btu = British thermal unit. NA = Not available.

Sources: ***AEO2003*:** AEO2003 National Energy Modeling System, runs AEO2003.D110502C (reference case), LM2003.D110502C (low economic growth case), and HM2003.D110502C (high economic growth case). **EVA:** Energy Ventures Analysis, Inc., *Energy Ventures Analysis Forecast—August 2002* (August 2002). **Hill & Associates:** Hill & Associates, Inc., *The Outlook for U.S. Steam Coal: Long-Term Forecast to 2021* (May 2002).